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A STUDY OF THE FOOD OF THE MINNOW CAMPOSTOMA ANOMALUM.*

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INTRODUCTION.

Study of the food of minnows is receiving more and more attention, (Breder and Crawford, 1922, p. 287), for the importance of the minnows as food of larger fresh-water fishes, involves the need of getting at the sources of the minnows' nourishment, which must be present in sufficient abundance, if the minnows and consequently the larger fishes are to thrive.

In this paper the food of the minnow Campostoma anomalum is considered. This fish is commonly called the stone-roller, but is also known by such names as stone-lugger, stone-toter, dough belly, rot-gut minnow, greased minnow, greased chub, steel-backed minnow, steel-backed chub, and mammy. It is a common fish in Ohio.

This minnow inhabits small rivers and creeks primarily, is found to great extent in moderate to swift current, and above rocky and pebbly bottom much oftener than above muddy or oftener even than above sandy bottom. It is a fish particularly of the riffles environment.

While the writer was a member of a state fish survey party, (summer of 1920, 1921), working under direction of Prof. R. C. Osburn, for the Ohio Division of Fish and Game, a very great many of this species were taken with the seine. These, as well as some sent by the party in the field in the summer of 1922, were available for the writer's use, and the latter during the same summer, collected many young specimens in the vicinity of Columbus.

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The writer is particularly indebted to Dr. R. C. Osburn, as well as to Mr. E. L. Wickliff and other members of the survey party, and to several other friends and colleagues who helped seine.

For the last two years the writer was engaged in a research on some anatomical features of this interesting species, the results of which work will be published elsewhere. Some 600 specimens were utilized, which had come from a total of 39 Ohio counties, and most were available for food examination. What was thought to be a sufficiently large number, were examined, and all of these are tabulated and discussed below.

PREVIOUS STUDY.

The food of Campostoma has apparently been studied previously in only a few specimens. Forbes, (1883, and reprint, 1912, pp. 69-72), gives the only idea of the nature of the food, and these observations seem to have been used without further investigation later, (Forbes and Richardson, 1908, p. 111).

"Of the great number of specimens available for dissection only nine were studied, since the contents of the intestine were found so uniform in character. * * * The intestine was invariably filled from end to end with a black slimy matter, which, * * * was found to consist almost wholly of fine mud. * * * It (the organic matter) made on an average only about one-fourth of the contents of the intestine, the remainder consisting of finest particles of sand and clay. Not far from one-fifth of the whole amount was of vegetable origin, consisting chiefly of filamentous algæ, mingled with a few diatoms, but comprising occasionally minute fragments of other kinds of vegetation also. The only animal objects noted were occasional Chironomous larvæ and Difflugia. Sometimes the intestine was wholly filled with almost pure mud, in which no organic structures whatever could be detected. Date and locality seemed to make no material difference in the food of this fish, which should evidently be classed as limophagous."

FOOD HABITS OF CAMPOSTOMA.

Campostoma is a bottom feeder for the most part. The head is somewhat sucker-like in general shape, the mouth being ventrally directed, and thus in striking contrast to the more

definitely terminal or forwardly directed mouth of many other minnows, such as Notropis, and Semotilus for instance, which are fitted for carnivorous prehension. The lips of Campostoma are fleshy and suggest the sucker lip of not too pronounced type.

Campostoma is particularly adapted to feeding on the diatomaceous and other growths adhering to stones on the bottom of the riffles. The dust fine detritus is no doubt easily ingested, and adhering material appears to be taken about as readily. The writer has observed some Campostoma feeding on stones in a natural habitat, and more extensively in a laboratory aquarium.

There were very few large stones in the aquarium; some of the bottom was covered with pebbles, and a small part was bare. Occasionally a specimen was seen to feed on the bare bottom part, where there was a thin film, probably diatomaceous. More frequently they were probing around among pebbles, very likely feeding. Both algæ and diatoms were thriving there. In the absence of current, the aquarium was entirely unlike their natural habitat. There was no great amount of loose detritus present, in which respect the environment was similar to that of many swift stream bottoms, where the current would remove loose materials. Most of the feeding was witnessed on the sides of the aquarium. For some months, (during which repeated observations were made) the glass walls of the aquarium were covered with a rich plant growth, largely diatomaceous. While this upright position does not seem normal, it seemed to do very well, and certainly presented the richest supply of food. The fish would frequently feed there by coming up against the glass surface, moving along it for a distance of a half inch or so, apparently swallowing as much of the diatomaceous deposit as possible, and then leaving the place for the time being. Short, narrow, cleared spaces, where they had removed the film, could be seen. While a number of artificial conditions existed here, so that the food supply most likely did not prove normal, or adequate, as indicated by the subnormal rate of growth of aquarium fishes, the manner of feeding could be adequately studied in this way.

METHOD OF EXAMINATION OF FOOD.

Because of the long type of intestine, which is small in diameter and coiled, and because of the small size of the particles comprising the intestinal contents, which are generally well packed into this long intestine, the examination of the food of the species is painstaking work. In the adult fishes the intestine is relatively much longer than in the young. It was seen that there was great uniformity along practically all of this length, so that only sections of it were taken, and carefully examined, but these were from near both ends and also middle parts of the canal. Possibly upwards of a third of the total length was examined in all cases. In all young specimens of groups 1 and 2, the entire contents were examined.

The contents, of either an entire canal of a young fish, or of a short section of an older one, were completely spread out over a 3 by 4 inch glass plate, covered with a film of water, and examined with both binocular and compound microscope. The high power (440 diam.) was used for the final examination of all plates. Considerable care was necessary in spreading out the material evenly and widely, so that all portions were clearly distinguishable, and so that estimates of the percentage composition by volume could be made with reasonable degree of fairness. In all cases the determination of what percentage of the total contents any particular kind of food was, rested purely upon an estimate in which a considerable percentage of error was possible, at least where the item concerned was very small in amount and distributed in relatively small sized particles as compared with some other type of food. In all cases the sum of the percentages of foods present is made to equal 100% exactly. It is not to be expected that a figure of 48% or 49%, for an item in some particular fish, represents the quantity of that type of food present, any more accurately than would the figure 50%; the 1%, or 2%, may have been necessary allowance for some small item of food present. There are many instances of small portions in intestinal contents, where the figure 1% seemed just about correct. In some cases such figure might be excessive, but no use of fractional percentage seemed desirable or possible, and the writer wished to obviate the use of the word trace.

THE SPECIMENS STUDIED, WITH TABULATION OF DATA ON INTESTINAL CONTENTS.

Both young and mature specimens were examined for a study of the food of the species. Five groups of 21 specimens were selected, in addition to which there was a small group of lake specimens. Specimens of the five groups have been grouped according to several features, chief of which is size of fish. It is logical to consider generally relation between size of fish, (and hence of its mouth), and size of particles or objects ingested, though where the food consists of such minute objects, this reason may have little or no weight. The specimen number is merely arbitrary, but it happens that, in any collection, numbers were usually assigned according to size of specimens. The arrangement of individuals in a group, where they do not follow a size series, is of no significance.

Group 1, (table 1), consisted of 21 very young Campostoma, including some of the smallest taken in the entire study. Sixteen of these were from a very small creek, tributary to the Olentangy River, north of Worthington, Franklin County. This run averaged only 2 to 3 feet wide, and was a favorable breeding place. These 16 were merely a portion of the collection, taken at one date and one place, all evidently of one school, and probably of the same age. This is a selection showing range in size of specimens of the collection, rather than a selection of all specimens of one size, at an extreme or average of the body length of the fishes. It is notable that specimens which are very likely of one age, show such difference in size so early in life. The variation in length of a large group is a continuous one, with most specimens at about the median point. For groups 2 and 3 a similar selection of range in size was made.

Group 2, (table 2), includes 21 young Campostoma taken entirely from Big Run, a small creek, tributary to the Olentangy River, north of Clintonville, Franklin County. This is somewhat larger than the run west of Worthington. It is also a favorable breeding place. The specimens were collected later in the month than those of table 1, though the different length of the group as a whole compared with group 1, cannot be attributed to a definite difference in age, since one cannot tell whether the eggs hatched at the same time or not in the two

places. The last 15 specimens were collected at later date than the first 6, as shown in the table. They belonged to the same general school very likely.

Group 3, (table 3), is likewise a selection of 21 young specimens from Big Run, but collected later in the summer when they were larger.

Group 4, (table 4), includes 21 specimens of a wide distribution, from 21 different streams, although some of these streams are tributary to others represented in the table. With the exception of the north and northwestern parts, all sections of the state are represented. Even a wider distribution might have been made, but for the desire to keep to a certain narrow range in specimen length. The minimum of 50 mm. makes all specimens in the group of greater length than those of preceding tables.

Group 5, (table 5), includes 21 specimens also taken from a wide distribution, but not necessarily from the same places as those of table 4. Somewhat fewer streams are represented, since suitable large specimens were not at hand from others. Many of the largest specimens, and especially practically all those of 100 mm. or greater length, are included here. This selection should be a satisfactory lot for the study of the adult food.

TABLE 1. INTESTINAL CONTENTS OF 21 VERY YOUNG CAMPOSTOMA.

Fish						Types Eaten with Percentages by Volume														
Specimen No.	Date of Collect.	Locality—Stream	Length of Fish	Length of Intest.	Degree Filled	Bacteria	Diatoms	1-Cell Blue-green	1-Cell Green Algae	Filamentous Green	Leaf of Plant	Unrecog. Plant Rem.	Protozoa	Rotifers	Copepoda	Cladocera	Ostracoda	Fly Larvae	Unrecog. Animal Rem.	Inorganic
294	June 3	Run west of Worthington	13	12	½		85			5								10		
300	"	" " "	14	15	¼		30			55										15
301	"	" " "	15	17	¾		15			5				5	40	20	5		5	5
302	"	" " "	15	19	¾	5	75			5				5						10
303	"	" " "	15	19	½	5	50					10		5	10					20
304	"	" " "	15	19	1		35			30				5	10	10				10
322	"	" " "	17	26	1	2	85					3								10
327	"	" " "	17	24	1					80		15								5
335	"	" " "	18	27	1	3	80					5								12
340	"	" " "	18	22	1			3		40				2		50				5
342	"	" " "	19	30	¾			3					2	95						
343	"	" " "	19	24	¾		75	6												16
344	"	" " "	19	27	½	5	15			35	15	15								15
345	"	" " "	19	30	¾		88													12
352	"	" " "	19	27	½	5	10	10		20	20	15		5						15
353	"	" " "	20	26	1		90													10
366	June 9	Scioto—Big Run	18	22	¾	5	15	15				40		10						15
367	"	" "	18	29	¾	1	15	30				40	4							10
371	"	" "	22	35	½	5	65	10				10								10
372	"	" "	22	41	½		90													10
373	"	" "	23	36	1	4	35	25	15			5								16

TABLE 2. INTESTINAL CONTENTS OF 21 YOUNG CAMPOSTOMA.

Fish						Types Eaten with Percentages by Volume										
Specimen No.	Date of Collect.	Locality—Stream	Length of Fish	Length of Intest.	Degree Filled	Bacteria	Diatoms	Desmids	Filamentous Green	Unrecog. Plant Rem.	Cladocera	Setae of Annelida	Midge Larvae	Egg of Insect	Unrecog. Animal Rem.	Inorganic
375	June 14	Big Run, Clintonville	25	65	1		1			9			85			5
379	"	" " "	23	39	¾	7	60	4	7	12						10
380	"	" " "	23	44	1	10	70	3		7						10
382	"	" " "	24	41	½		2			5			90			3
383	"	" " "	24	46	¾	3	80	7								10
386	"	" " "	25	59	1	5	75	6		4						10
388	June 19	" " "	26	54	1	4	80			6						10
389	"	" " "	29	97	1	1	83			4						12
391	"	" " "	24	48	1	1	70	10		4						15
392	"	" " "	24	38	¾		65	3	10	10						12
396	"	" " "	25	63	1	2	70	3	10	4	3					8
400	"	" " "	26	42	1		75	4		6						15
401	"	" " "	26	57	½	5	55	5		20						15
405	"	" " "	27	60	¾	1	60	4	5	10						20
407	"	" " "	28	60	¾	5	60	4	1							30
416	"	" " "	29	73	1	2	55	5		20		3				15
417	"	" " "	28	68	1		65	5		10						20
418	"	" " "	30	74	¾		55	6	5	10		4				20
423	"	" " "	29	64	¾		65	5		10					5	15
424	"	" " "	29	71	1	5	50	5		15						25
427	"	" " "	29	87	1		55	8	6	10				1		20

TABLE 3. INTESTINAL CONTENTS OF 21 YOUNG CAMPOSTOMA.

Fish						Types Eaten with Percentages by Volume.												
Specimen No.	Date of Collect.	Locality—Stream	Length of Fish	Length of Intest.	Degree Filled	Bacteria	Diatoms	1-Cell Blue-green	Filamentous Blue-green	1-Cell Green Algae	Desmids	Filamentous Green	Leaf of Plant (part)	Unrecog. Plant Rem.	Setae of Annelida	Midge Larvae	Egg of Insect	Inorganic
482	July 15	Big Run, Clintonville	37	111	¾		40							30				30
484	"	" " "	39	114	¾		50				5	5		10				30
485	"	" " "	39	138	1	8	45				2	5		20				20
524	August 5	" " "	39	119	¾		30					15		15				40
526	"	" " "	39	101	½		30					10		10				50
528	"	" " "	42	128	¾	4	30					5		20	1			40
529	"	" " "	42	143	1	3	40	1	1			5		20				30
530	"	" " "	43	160	¾		40		10			10		15				25
531	"	" " "	44	157	1	5	25	1	4			20		15				30
533	"	" " "	43	156	¾	1	25	1	8			15		15				35
534	"	" " "	42	146	1	3	25	1		1		5		20		5		40
535	"	" " "	44	178	1	3	30	2		1	1	5		18				40
536	"	" " "	43	191	1	5	25				1	4	10	15				40
537	"	" " "	44	192	1	5	25					5		10				55
538	"	" " "	45	167	¾	4	20		2			4		10				60
540	"	" " "	46	207	1	1	20				1	3		10				65
541	"	" " "	47	188	1	1	30				1	5		8				55
542	"	" " "	47	196	¾	4	30	1				10		5				50
543	"	" " "	48	202	¾	1	40				1	5		8				45
545	"	" " "	48	198	1	2	40					4		10			2	42
547	"	" " "	49	195	1	1	30	1				3		5				60

TABLE 4. INTESTINAL CONTENTS OF 21 CAMPOSTOMA.

Fish							Types Eaten with Percentages by Volume.										
Specimen No.	Date of Collect.	Locality Collect.—Stream	County	Length of Fish	Length of Intest.	Degree Filled	Bacteria	Diatoms	1-Cell Blue Green	Filament. Blue-Green	1-Cell Green Algae	Filamentous Green	Desmids	Unrecog. Plant Rem.	Protozoa (Euglena)	Unrecog. Animal Rem.	Inorganic
61	June 17	Cold Water Run	Columbiana	52	212	1	1	50		1		2		4			42
66	" 18	N. Fork, Little Beaver	Columbiana	55	245	¾	3	75					1	6			15
73	" 21	Cross Creek	Jefferson	58	355	1	1	5		1				3			90
75	" 29	McMahon's Creek	Belmont	55	275	1	2	8				5	2	3			80
77	" 30	Sugar Creek	Guernsey	56	296	1	1	3				1		15			80
84	July 7	Duck Creek	Noble	58	280	1	1	5		2				22			70
94	" 11	Newell's Creek	Washington	53	222	1	1	1		1		1		10		1	85
101	" 13	Wolf Creek	Washington	50	169	½		1						8	1		90
109	" 14	Hocking River	Athens	54	302	¾	5	15				3		12			65
119	" 19	Indian Guyan Creek	Gallia	51	130	1	1	1		3		35		10			50
127	" 21	Turkey Creek	Scioto	57	315	1	1	48		4		40		2			5
152	Aug. 1	E. Fork, Little Miami	Clermont	57	197	¾	1	7				5	1	6			80
159	" 5	4-Mile Creek	Butler	50	234	1	1	5		1				8			85
177	" 8	Little Miami River	Warren	53	302	1		5		5				10			80
189	" 8	Big Miami River	Warren	51	200	¾	1	4						5			90
205	" 22	Licking River	Muskingum	52	241	1	2	6			1		1	10			80
215	" 25	Walhonding River	Coshocton	56	265	1	1	20				10	1	15			53
227	" 25	Mohican River	Coshocton	56	259	1	1	25				1		13			60
233	" 26	Tuscarawas River	Coshocton	53	212	1	1	20		2				10	2		65
257	Sep. 13	Olentangy River	Franklin	53	250	¾	1	7	1	3				15	3		70
288	May 5	Big Walnut Creek	Franklin	55	225	1	2	60				1		7			30

TABLE 5. INTESTINAL CONTENTS OF 21 ADULT CAMPOSTOMA.

Fish							Types Eaten with Percentages by Volume												
Specimen No.	Date of Collect.	Locality—Stream	County	Length of Fish	Length of Intest.	Degree Filled	Bacteria	Diatoms	1-Cell Blue-green	Filamentous Blue-green	Desmids	Filamentous Green	Unrecog. Plant Rem.	Protozoa (Euglena)	Setae of Annelida	Egg of Insect	Midge Larvae	Unrecog. Animal Rem.	Inorganic
2	June 20	Hocking River	Fairfield	92	349	½	7	7			1						75		10
5	" 20	Hocking River	Fairfield	90	401	¾	3	35			3	4	10				5		40
10	Aug. 18	Mahoning River	Trumbull	93	507	1	3	25			3	4	10				5		50
42	July 17	Mosquito Creek	Shelby	77	282	½	5	5					15				5		70
46	" 28	Beaver Creek	Mercer	86	655	1	3	5		1	1	1	8			1			80
50	Aug. 26	Deer Creek	Madison	79	416	1	2	35		2	2	4	10						45
70	June 20	M. Fork, Little Beaver	Columbi'na	89	660	1	2	10		8		2	10						68
99	July 12	Wolf Creek	Washington	80	335	½	2	2		5			6						85
170	Aug. 17	Mahoning River	Trumbull	110	614	¾		10		1		3	6						80
202	" 12	Little Miami River	Greene	84	650	1	4	6		15			5						70
212	" 22	Licking River	Muskingum	76	441	1		10		5	5	5	5						70
213	" 23	Jonathon Creek	Muskingum	87	377	½		15					20						55
214	" 23	Walhonding River	Coshocton	86	422	¾	2	10		10		5	20				3		50
243	" 24	Killbuck River	Coshocton	75	283	¾	5	20				10	15						50
244	" 26	Tuscarawas River	Coshocton	88	471	1	8	8				1	7		1				75
256	Sep. 13	Olentangy River	Franklin	83	565	1	1	10	1	10			4	4					70
266	" 13	Big Walnut Creek	Franklin	83	484	1	4	50				1	10						35
281	May 5	Big Walnut Creek	Franklin	87	468	1		85				1	5						9
282	" 5	Big Walnut Creek.....	Franklin	75	386	¾		55		10			5						30
491	July 17	Big Walnut Creek	Franklin	78	287	½	5	15			3	5	15	2				5	50
575	" 3	Tontogany Creek	Wood	84	624	¾	2	15		10		3	10						60

DISCUSSION OF THE FOOD.

In bulk the entire intestinal contents make a compact mass, in many cases quite filling the canal, though occasionally there are parts where it is somewhat loosely placed or where short sections are clear. Only where it was completely filled throughout was it considered filled and marked 1 in the column "Degree filled" in the table. In very few cases examined was it as little as one-half filled. Though of a generally very soft consistency, the contents were hardly "slimy" as Forbes described the mass, except where there was a large mass of filamentous algæ of slimy feel. Examination showed that the soft contents were really very gritty. The color was rarely black, generally some shade of brown, from light to very dark, with more or less of a greenish tinge.

Inorganic matter was seen to be a considerable item in the canal contents. To be sure this was not thought of as food itself, but a prevalent large percentage of it indicates that it is a normal constituent of the canal contents, and evidently something unavoidably taken in, with some mixed organic material, in its method of feeding along the bottom. The inorganic material was found to be of rather uniform nature in all the specimens. The largest portion of it, giving to the whole its gritty consistency, was sand in minute grains or crystals, generally so small as to be scarcely visible individually under the ordinary powers of the binocular, but prominent under the high power of the microscope. There were some much larger grains, but also many smaller than the average, as if ordinary sized grains had been ground up, though there must be very little of such process going on in the alimentary canal of the fish, and very likely great masses of such triturated material exist on the bottom.

A smaller portion of the inorganic constituents comprised softer material, apparently clay, in fine granules, smaller than most of the smallest gritty particles.

In both groups of very young specimens (Tables 1, 2), there was not nearly as much inorganic material present as described by Forbes for this species. The average is about 15%. But even in the next larger group (Table 3), a much larger and somewhat uniform percentage is present. In the adults and other large specimens, (Table 5 and also Table 4) the percentage is

high, except in a few specimens. In many it is as Forbes indicates, three-fourths inorganic and one-fourth organic. These percentages are sufficient to indicate that a larger mass of inorganic material is ingested in the more wide-spread feeding of the older fish, and that the relatively small percentage of organic material furnishes enough nutriment which can be absorbed in the long course of the intestine. But in younger fishes, having relatively so short an intestine, inadequate nourishment might result from such a small percentage of organic material. It can hardly be concluded that the young fish selects its food, and that an early selective action is later lost. The contrast, however, between the fairly uniform percentages of the young and those of the old, marks this difference as significant, whatever the cause.

Among the various items of the diet is that referred to as unrecognizable plant remains (Unrecog. Plant rem., as expressed in the table). A careful separation of diatoms and other plant materials from masses of inorganic matter, disclosed some small pieces of green substance in practically all fishes, which seemed to defy all identification. Considerable breaking up from original condition undoubtedly occurred, due probably to grinding up by the gritty inorganic matter, with which it was closely bound up. It was in all cases in this study impossible to say what the source was, whether algæ or some other plant. Varying quantities of distinguishable plant material also were present (as listed in the tables), and of these all the smaller forms (unicellular blue-green algæ and green algæ, as well as the diatoms), were entirely intact. Likewise filaments of short length of both blue-green and green algæ were present. Of the latter numerous, very short and much broken pieces, often only one cell pieces, were found, so that it seems that further trituration of such, by means of the gritty inorganic matter, may account for some of the unrecognizable plant remains. Contents of various plant cells may also give to small masses of inorganic matter, a green tinge. In fact, at first large unrecognizable masses were frequently noted, of somewhat greenish tinge under the light coming through the compound microscope, but it was soon realized that all such had to be laboriously broken up, for masses of elongate diatoms placed criss-cross fashion, together with granules and a little plant substance, made dense masses, which had to be much separated

before constituents with percentages for each could be fairly recorded.

Diatoms formed in practically all instances a prominent item of food. In by far the most adult specimens they formed the largest item of organic material, but were overshadowed (except in a few cases) by the inorganic constituents. But it was in the young specimens that diatoms formed such a preponderant part of the entire canal contents. Excluding a few striking exceptions, the diatoms formed in them from half to nine-tenths of the total. In fishes of one locality the diatoms are mostly of just one or a few species. In fishes of groups 1 and 2, coming from three localities, the diatoms were slender elongate species of Navicula, or some species of the very slender genus Nitzschia, with a relatively few of forms like Gomphonema and Tabellaria. No real identifications were attempted in this or other groups of food organisms. Altogether in the food survey here made, at least a dozen kinds of diatoms were present, but never so very many species in one intestine. In the fishes of Table 5, though coming from various localities, there was a preponderance of just a few forms, of which an outstanding type was a somewhat Navicula-like form, short, but bent, possibly Cymbella. In some young specimens, masses of very slender, elongate diatoms were sometimes massed like clumps of needle-like crystals, held by minute quantities of other substances.

Bacteria formed an appreciable percentage in quite a number of fish. Examination showed that, smaller than practically any other particles, and of more regular shape, but not always positively distinguishable from the smallest regular clay or silt-like particles, were some small oval to short rod-shaped forms, that would vibrate with Brownian movement in the dilute food smears on the slides. That they were bacteria there was no doubt, but what their role in the food was, or whether rather intestinal flora than an item of diet, could of course not be determined.

The filamentous green algæ, found in a considerable number of specimens, but in very different proportions, presented quite a variety. Spirogyra was oftenest found, but Mougeotia, Zygnema, Oedogonium, and Vaucheria were also represented in some fish.

In a relatively few specimens among the hundreds of Campostoma collected, there were present large masses of

filamentous algæ. None of the specimens studied in detail for food here happened to contain such a large preponderance as did these few striking cases. In these the filaments were very long, instead of broken up, gave a greenish-black color to the entire intestine, made it of softer consistency, and often pierced the weakened walls of the intestine when it was being examined. In these few the filamentous algæ comprised nearly 100%.

The animal food was present in much smaller amounts than the plant food in the specimens examined, but this is due probably merely to the smaller proportion of small animal forms inhabiting stream bottoms.

In a few individuals there was a striking difference from this almost universal rule. Among the 16 specimens from the run west of Worthington, (Table 1), there were five particularly which were unusual in possessing a diet very differently proportioned from the rest, in spite of the fact that they fed in the same locality as all the rest. Moreover these five differed strikingly among themselves. One had ingested 55% filamentous algæ, one 80% filamentous algæ, with an entire absence of diatoms, while the other three had large percentages of animal forms, offering thus a remarkable point of contrast to the others and also to all other Campostoma from any stream examined. One of these contained 50% Cladocera, as well as 40% filamentous algæ, another 40% Copepoda and 20% Cladocera, and the other 95% Rotifers. All of the latter were Anuraea, which in mass produced a delicate pink color, so unlike that of any other Campostoma. The Cladocera present in the specimens just referred to, were mostly Chydorus sphaericus, with a smaller proportion of a species of Daphnia. Of the 21 fish of group 2, there were two which were strikingly different in food ingested. These had consumed almost entirely animal food, midge larvæ in both instances. The reason for such distinct differences and for the individual ingestion of large proportions of some animal food, is not at all evident.

CAMPOSTOMA FROM LAKES.

Campostoma may occasionally be found in lakes. In Illinois, Forbes and Richardson, 1908, p. 99), found it present, (expressing the figures as coefficients of frequency), to the extent of .05 in lakes, as compared with 3.28 in creeks, 2.22 in small rivers, and .21 in large rivers.

TABLE 6. INTESTINAL CONTENTS OF 8 LAKE CAMPOSTOMA.

Fish						Types Eaten with Percentages by Volume									
Specimen No.	Date of Collect.	Locality of Collect. Lake	Length of Fish	Length of Intest.	Degree Filled	Bacteria	Diatoms	1-Cell Blue-green	Filament. Blue-green	1-Cell Green Algae	Desmids	Filament. Green	Unrecog. Plant Rem.	Setae Annelida	Inorganic
45	June 26	Lake St. Mary's	33	111	1	2				15	3	15	30		35
47	Aug. 14	Summit Lake	37	78	½	3	10	1	5				35	1	45
48	" 16	Milton Reservoir	36	109	¾	2	15		18				25		40
249	Sep. 1	Buckeye Lake	36	146	1	4	20			2	2	2	20		50
556	June 30	Nettle Lake	26	95	1	1	55		5			1	10		28
561	" "	" "	30	135	1	1	45	1	3				15		35
564	" "	" "	35	130	¾	1	20	1			1	15	12		50
565	" "	" "	34	160	¾	2	35	2	10		1		10		40

In the present work a relatively very small number were secured from lakes, although fully as much seining proportionately was done in lakes as in streams, so that the scarcity of this species in lakes is demonstrated. All lake specimens at hand were used, (table 6), except a few from Nettle Lake, where a fair number were obtained. The specimens included in the table were thought to be sufficient. In fact, in no case, even in the study of the young creek specimens (tables 1, 2, 3), were all individuals used that were collected.

In lakes the species appears to be restricted to certain few parts where environment compares favorably in at least some important features, with that of streams, where Campostoma is usually found. Of course it is not to be expected that lake specimens are individuals adapted to deep water, or to shoreward marshes, etc. Different lakes would differ much in their likelihood of harboring Campostoma. The five lakes represented are far apart and differ in many details, which are of no import here, except to show that Nettle Lake is evidently more uniformly of a sort suitable for the existence of this fish. It is shallow, clear, and has a sandy bottom throughout. In the case of the other lakes, the Campostoma taken were also from situations near shore where there was similarly a sandy or a somewhat pebbly bottom.

Examination of table 6, and a comparison with all preceding tables, shows no striking general difference between the stream and lake Campostoma. The latter are in part, of similar size as specimens of table 2, although it happens that most are of length between those of tables 2 and 3. If one considers all these more or less comparable specimens, and excludes especially the few very unusual diet individuals from the stream series, very little appreciable difference in diet is noticeable between stream and lake specimens, although one might conclude that there were slightly fewer diatoms, somewhat more algæ, and somewhat more inorganic matter in the lake specimens. Granting that these differences are negligible, it is nevertheless true that there seems to be a larger variety and possibly a larger quantity of algæ. In the diet of a few of the lake specimens were found Pediastrum and one or two other green algæ, absent from stream specimens. These are typical lake forms, though not generally found on the bottom. Their presence, but in such small percent, is then just what one might expect.

This data, though meagre, really shows that there is no particular selection of food organisms, for the lake specimens consumed such food as was present. The diet was similar to that of the majority of stream specimens, merely because the habitats presented in most respects the same general types of food materials. This is a prerequisite. In lake environments differing much from streams in the available food supply, Campostoma would not be found.

The question of the larger differences between the stream fauna and flora and that of the particular lake habitats in which Campostoma was secured, does not enter here. In no case has there been available, detailed, comparable collections of all the organisms of these waters in order to make comparison between existing fauna and flora and that which was ingested.

SUMMARY AND CONCLUSIONS.

Campostoma anomalum, a fish of wide distribution in Ohio, is primarily found in or on riffles in streams.

A study of the intestinal contents of a considerable series of specimens of various sizes and from many streams, seems to allow the following conclusions.

This species of fish is a bottom feeder par excellence, the ventrally directed mouth being applied in removing both loose bottom materials and attached growths. Particles ingested are generally of microscopic size, except that in some instances fairly long filaments of filamentous algæ may be ingested.

A large amount of inorganic material is present in the canal. Often as much as three-fourths of the total is of inorganic nature in the adults. In the young there is a uniformly smaller percentage.

Organic material is present, forming in the adults from less than a fourth to fully a half of the contents, and in the young generally from three-fourths to nine-tenths of the total.

Plants are far more abundant than animals in the diet, there being only trifling amounts of the latter, except in a few exceptional cases where certain animal organisms were taken in large quantity.

Diatoms form the preponderant item of organic nature in the alimentary canal, of both young and adult, except for a few unusual cases. In young fishes diatoms may form from one-half to nine-tenths of the total contents.

The difference between young and adult can hardly be explained on the basis of selection of food, but there is a correlation between the much lower percentage of organic material in the adult and its relatively very long intestine.

The few instances of striking differences in diet of young fishes from that of the rest taken at exactly the same place and time, is not explicable at present.

A few lake specimens showed no notable differences in diet. These specimens were from situations that resembled in some important features, some general stream habitats.

On the whole the diet is such as one might naturally expect in the environment which Campostoma frequents. A general uniformity of diet among large numbers of specimens is not remarkable, considering the uniformity of its habits and habitats.

This minnow is particularly valuable as fish food, because it forms in one step [like the gizzard shad in a different aquatic situation, (Tiffany, 1920, p. 121)], the chain from the very fundamental microscopic food materials, to the game fishes. It ingests directly the abundant, rich bottom debris, living upon diatomaceous and other organic remains. It serves as good food for game fishes. Furthermore it is common and tenacious of life. It must receive important consideration in any future, more intensive fish cultural practice.

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OHIO RECORDS OF THE JUMPING MOUSE.
Zapus hudsonius, Zimmerman.

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This species has been assumed to be present in Ohio by the earlier writers, because it was known to be found north, south, east and west of it, but definite records of its occurrence in the state seem to be very few. A. W. Brayton in his Report on the Mammalia of Ohio, Vol. IV, p. 132, Geological Survey of Ohio, states "Mr. Langdon has recognized it satisfactorily in Ohio, but mentions no specific locality." Mr. Brayton observes that "We should naturally expect an animal (in Ohio) whose dispersion is probably not less than that of *Hesperomys leucopus*, particularly as it shows a strong preference for woodlands and as there are no very extensive treeless areas in Ohio."

I have found three definite records of its occurrence in this state. The first is recorded in the Second Annual Report of the Ohio Academy of Science, p. 15. Ernest W. Vickers exhibited a specimen at the second annual meeting, 1894, taken in a grain field, September, 1893, at Ellsworth, Mahoning County. Two more were captured and others seen later in September. The second is in North American Fauna, Bull. 15, p. 17, Aug., 1899, where E. A. Preble records it from Portland Station, doubtless Portland in Meigs County, well toward the southeastern part of the state. The third is in the Ohio Naturalist for June, 1906, Vol. VI, p. 551, where Professor J. S. Hine says: "The jumping mouse, *Zapus hudsonius americana*, was observed to be abundant in certain parts of Summit County last summer. Mr. Eugene F. Cranz captured a number of specimens at Ira. They were found mostly in fields of standing grain and hay."

I am able to add a fourth record because in December, 1922, I received from County Agricultural Agent C. O. Reed, of Tiffin, Ohio, a specimen of this mouse, collected by Mr. Frank Hepp of Berwick, Seneca County, Ohio. Mr. Hepp writes: "They made their appearance in our neighborhood about 5 or 6 years ago, at least they first attracted my attention at that time. They seem to live in colonies in some localities, as about New Riegel. They are now quite plentiful in some other localities. I have yet four mounted specimens."

Dr. R. C. Osburn also reports that specimens, said to have been collected in Scioto and Ross Counties, have been brought to him, making in all six authenticated records for the state.

In the publications of the Field Museum of Natural History, Zoological Series, Vol. XI, p. 251, Feb., 1912, C. B. Cory gives a map illustrating the approximate distribution of this species and indicates that it is found over the whole of Ohio except in a few of the southern counties along the Ohio River.

Ernest Thompson Seton in his Life Histories of Northern Animals or Mammals of Manitoba, gives in Vol. I, p. 589, a provisional map which includes only the northern one-third or one-fourth of Ohio in its range. If Preble's record refers to Portland in Meigs County, the map by Cory is the more nearly correct.

An inquiry addressed to Gerrit S. Miller, Curator of Mammals, U. S. Nat. Mus., has failed to uncover any additional Ohio records. The only Ohio specimen in the National Museum is the one collected by E. A. Preble.

The specimen sent me by Mr. Hepp seems to be typical *hudsonius*, 8 inches long, hind foot 1 1-8 inches long, tail 4 5-8 inches in length. The coloring is also typical for *hudsonius* so far as can be determined from the printed description.

NATURAL HISTORY.

This mouse is commonly found in thickets by meadows and along the edges of woods. The prairie form is an inhabitant of the prairie border-lands, usually near low thickets of brush and weeds, near streams or ponds, among groves of the half-open country.

The species is never abundant in the sense that we apply that word to other species of mice. As an example of maximum abundance it is recorded that E. A. Preble once obtained a score of specimens in four days at Oxford House, Canada.

It is a solitary species, except that a family seems to stay together near the mother until they are nearly grown. In Iowa, twenty-five or thirty years ago, the writer saw 5 or 6 of a family in action almost simultaneously, much like a bunch of frogs behave when startled. When quite young and until they are nearly grown, the offspring cling to the teats of the mother when she is frightened and are carried along with her in her leaps.

This mouse does not jump in ordinary traveling or when searching for food, but when escaping from danger, real or supposed. It may cover 10 or 12 feet at the first bound, three or four

others of 8 to 10 feet follow, then it slows down to leaps of 3 or 4 feet, which are continued until it considers itself out of danger. Its course of flight is often irregular, sharply angular or reversed according to necessity. In these leaps the long tail acts both as a rudder to steer the course and as ballast to keep the head skyward. G. S. Miller, Jr., in his Mammals of New York, refers to an individual that had lost its tail by the knife of a mowing machine. It could leap to a tremendous distance but had no power to steer its movements. Once launched into the air, its body would turn end over end, and it was likely to alight facing the direction from which it had come. The next frantic leap would carry it back to its starting point.

The species feeds on small seeds, such as *Amaranthus*, *Ambrosia*, burr-marigold, beggar or sheep ticks, beech nuts, berries and grain; also buds, leaves, twigs, bark, grass and almost any sort of vegetable growth. It stores grain, buckwheat and nuts for winter use.

It makes for the winter a warm, comfortable nest below the reach of frost, preferably under an old stump, and in this hibernates like the woodchuck and skunk. It may awaken from its torpor several times during the winter if warm periods violently alternate with cold ones.

While departing considerably from the burrowing type of mouse, this species is a true burrower and in summer lives in short, shallow burrows underground; in fall and winter these are made much deeper.

The distribution of the type species is from Hudson Bay south to New Jersey and in the mountains to North Carolina, west to Iowa and Missouri and northwest to Alaska.

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A REVIEW OF THE GENUS PRIONOCHILUS STRICKLAND AND ITS CLOSEST ALLIES.

HARRY C. OBERHOLSER.

The genus *Prionochilus* of the Catalogue of Birds in the British Museum* included several well differentiated generic groups. These have been partly segregated by subsequent authors, notably Oates,† Büttikofer,‡ and Hartert§; and the present paper is a further contribution to the same subject.

The old genus *Prionochilus* is now divisible into eight, which fall naturally into two main groups, one comprising three genera with a spurious primary, and another comprising five genera in which there is no evident spurious primary, and in which the wing is thus apparently nine-primaried, like most of the Dicaeidae. In fact, so different are these two groups that there is some doubt of the propriety of retaining the first mentioned in the family Dicaeidae.

In the present paper the comparative measurements used have been taken as follows:

Length of wing.—Measured in a straight line from the bend of the closed wing to the end of the longest primary, with the primaries in their natural position—that is, not straightened.

Exposed culmen (length of bill).—Measured in a straight line from the beginning of the feathers on the culmen to the tip of the maxilla—that is, the chord of the exposed culmen.

Width of bill at base.—Taken with dividers at the beginning of the feathers on the culmen.

Length of tarsus.—A straight line from the center of the heel joint on the posterior side to the middle of the joint between the metatarsus and the middle toe on the anterior side.

The conclusions hereinafter set forth are based chiefly on material in the United States National Museum. In addition, the writer is indebted to the authorities of the Academy of Natural Sciences at Philadelphia, Pennsylvania, through Dr. Witmer Stone, and those of the Museum of Comparative

*Sharpe, Cat. Birds Brit. Mus., X, 1885, pp. 63-76.
†Fauna Brit. India, Birds, II, 1890, after October, pp. 375, 381-386.
‡Weber's Zool. Ergeb. Reis. Nederl. Ost-Indien, 1894, pp. 302-303.
§Novit. Zool., IV, No. 3, December 3, 1897, p. 519.

Zoology, Cambridge, Massachusetts, through Mr. Outram Bangs; and to Mr. J. H. Fleming, of Toronto, Ontario, for the loan of additional specimens.

Pachyglossa Blyth.

Pachyglossa Blyth (Hodgson MS.), Journ. Asiat. Soc. Bengal, XII, Part II, No. 143, for November (after November 13), 1843, p. 1009 (type, by virtual monotypy,* *Pachyglossa melanoxantha* Blyth, Hodgson MS., sp. nov.)

Description.—First (outermost) primary spurious, not as long as the tarsus (not longer than hind toe with claw); third primary longest; second primary much longer than the seventh; secondaries falling short of the tip of the wing by more than the length of the tarsus; wing very long, nine and one-half times the length of exposed culmen; tail square or slightly emarginate; bill moderately stout and relatively broad, its lateral outlines concave, its width at base nine-tenths of the length of exposed culmen; culmen strongly decurved; gonys moderately ascending and moderately convex; narial bristles few and poorly developed.

Type.—*Pachyglossa melanoxantha* Blyth.

Remarks.—The only species is *Pachyglossa melanoxantha* Blyth.

Anaimos Reichenbach.

Anaimos Reichenbach, Handb. Speciell. Ornith., Nov. 1, 1853, p. 245, (type, by monotypy, *Pardalotus thoracicus* Temminck).

Diagnosis.—Similar to *Pachyglossa*, but first (outermost) primary at least as long as the tarsus; third, fourth, and fifth primaries longest; secondaries falling short of tip of wing by less than the length of the tarsus; wing less than 8 times the length of the exposed culmen; lateral outlines of bill practically straight; width of bill at base about $\frac{3}{4}$ of the length of the exposed culmen; gonys strongly ascending and much convex; narial bristles numerous and well developed.

Description.—First (outermost) primary spurious, but as long as the tarsus; third, fourth and fifth primaries longest; second primary much

*The expression "virtual monotypy," which has been previously used by the present writer, is intended to indicate that while in the original description of a genus there may have been more than one specific name mentioned, yet only one is to be considered in fixing the type. Such specific names include (1) nomina nuda, (2) absolute synonyms that could not by any possible chance be used for another species or subspecies, (3) species inquirendae from the standpoint of the author of the generic name, and (4) species doubtfully referred to the genus by its original describer. In the case of *Pachyglossa*, as above indicated, the following three other species were doubtfully referred to this group by Blyth: *Pipra squalida* Burton, *Piprisoma vireoides* Jerdon, and *Pardalotus pipra* Lesson.

longer than the seventh; secondaries falling short of the tip of the wing by less than the length of the tarsus; wing long, 7 to 7½ times the length of the exposed culmen; tail square, or very slightly rounded; bill moderately stout and relatively broad, its lateral outlines practically straight, its width at base about ¾ of the length of exposed culmen; culmen strongly decurved; gonys strongly ascending and convex; narial bristles numerous and well developed.

Type.—Pardalotus thoracicus Temminck.

Remarks.—This group is well differentiated from *Pachyglossa*, as may be inferred from the above diagnosis. The species are:

Anaimos thoracicus (Temminck).
Anaimos olivaceus (Tweeddale).

Charitociris,* nom. gen. nov.

Prionochilus STRICLLAND, Proc. Zool. Soc. Lond., 1841, (October, 1841), p. 29, (type, by subsequent designation [Gray, List Gen. Birds, ed. 2, August, 1841, p. 46], *Pardalotus percussus* Temminck), (nec *Prionocheilus* Chevrolat, *Coleoptera*).

Diagnosis.—Similar to *Anaimos*, but wing about 6 times the length of exposed culmen; second primary equal to the seventh, or shorter; bill relatively narrow and slender, not turgid, its width at base about three-fifths of the length of exposed culmen; culmen not much decurved, the gonys not strongly convex, nor strongly ascending.

Description.—First (outermost) primary spurious, but as long as the tarsus; third, fourth, and fifth primaries longest; second primary equal to the seventh, or shorter; secondaries falling short of the tip of the wing by less than the length of the tarsus; wing 6 times the length of the exposed culmen; tail square, or very slightly rounded; bill relatively slender and narrow, its lateral outlines practically straight, or but slightly concave, its width at base about three-fifths of the length of exposed culmen; culmen not strongly decurved; gonys moderately ascending and convex; narial bristles numerous and well developed.

Type.—Pardalotus percussus Temminck.

Remarks.—This genus differs from *Pachyglossa* in having numerous and well developed narial bristles; long secondaries, falling short of the tip of the wing by less than the length of the tarsus; the first primary at least as long as the tarsus, the second primary equal to or falling short of the seventh; the wing only 6 times the length of the exposed culmen; and in some other particulars.

**Charis*, gratia; *kiris*, ciris (avis mythica).

The generic name *Prionochilus* Strickland* is rendered invalid by *Prionocheilus* Chevrolat† for a genus of *Coleoptera*, as already explained by the present writer,‡ but the name *Anaimos* Reichenbach, that we used for this genus in its original sense, is not now applicable to the present group. It is further worth while mentioning that the type of *Prionochilus* Strickland usually cited is *Dicaeum ignicapillum* Eyton, but this species is not mentioned in the original diagnosis, and the proper type was therefore apparently first designated by Gray§ as *Pardalotus percussus* Temminck. The species referable to this group are as follows:

Charitociris percussa percussa (Temminck).
Charitociris percussa ignicapilla (Eyton).
Charitociris xanthopygia xanthopygia (Salvadori).
Charitociris xanthopygia plateni (Blasius).
(=*Prionochilus johannae* Sharpe).
Charitociris maculata maculata (Temminck).
Charitociris maculata septentrionalis (Robinson and Kloss).
Charitociris maculata opistata (Oberholser).

Piprisoma Blyth.

Piprisoma Blyth, Journ. Asiat. Soc. Bengal, XIII, pt. I, No. 149, for May (after October), 1844, p. 394, (type, by monotypy, *Fringilla agilis* Tickell=*Pipra squalida* Burton).

Diagnosis.—Similar to *Charitociris*, but first (outermost) primary not spurious, and much longer than the fourth; second and third primaries longest; secondaries falling short of the tip of the wing by more than the length of the tarsus; and the wing more than 7 times the length of exposed culmen.

Description.—First (outermost) primary not spurious, much longer than the fourth; second and third primaries longest; secondaries short, falling short of the tip of the wing by more than the length of the tarsus; wing long, 7½ to 8 times the length of exposed culmen; tail slightly rounded; bill rather slender and narrow, but broadening at base, its lateral outlines more or less concave, its width at base three-fifths to two-thirds of the length of exposed culmen; culmen not strongly decurved; gonys only moderately ascending and little convex; narial bristles few and rather weak.

*Proc. Zool. Soc. Lond., 1841 (October, 1841), p. 29.
†In Dejean, Cat. Col., ed. 3, 1837, p. 451.
‡Smithson. Miscell. Col., LX, No. 7, October 26, 1912, p. 22.
§List Gen. Birds, ed. 2, August, 1841, p. 46.

Type.—Pipra squalida Burton.

Remarks.—The three preceding genera all have a spurious first primary, so that *Piprisoma* is distinguishable from them at a glance.

The generic term *Piprisoma* is not of neuter gender as commonly considered, since, being a compound appellative, it must be either masculine or feminine. In view of the feminine form of its ending, it is probably better considered to be of that gender.

The species referable to this genus are:

Piprisoma modesta modesta (Hume).
Piprisoma modesta remota Robinson and Kloss.
Piprisoma everetti everetti (Sharpe).
Piprisoma everetti sordida Robinson and Kloss.
Piprisoma squalida (Burton).

Cryptociris,* gen. nov.

Diagnosis.—Resembling *Piprisoma*, but with secondaries long, falling short of the tip of the wing by less than the length of the tarsus; width of bill at base more than three-fifths of the length of exposed culmen; tail strongly rounded.

Description.—First (outermost) primary not spurious, much longer than the fourth; first, second, and third primaries longest; secondaries long, falling short of the tip of the wing by less than the length of the tarsus; wing long, about $7\frac{3}{4}$ times the length of the exposed culmen; tail strongly rounded; bill rather slender and relatively narrow, but broadening at base, its lateral outlines more or less concave, its width at base about $\frac{3}{4}$ of the length of the exposed culmen; culmen not strongly decurved, but relatively more so than in *Piprisoma;* gonys only moderately ascending and moderately convex; narial bristles few and weak.

Type.—Pardalotus obsoletus Müller and Schlegel.

Remarks.—This monotypic group is most nearly allied to *Piprisoma*, but is readily distinguishable as above indicated. Its only species is *Cryptociris obsoleta* (Müller and Schlegel).

Chromatociris† gen. nov.

Diagnosis.—Similar to *Cryptociris*, but with the second, third, and fourth primaries longest; the first (outermost) primary shorter than the fourth; wing not decidedly more than 7 times the length of the exposed culmen; tail only slightly rounded; bill stouter; culmen strongly decurved; narial bristles more numerous and better developed.

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* *kryptos*, color; *kiris*, ciris (avis mythica).
† *Chroma*, occultus; *kiris*, ciris (avis mythica).

Description.—First (outermost) primary not spurious, but shorter than the fourth and equal to the fifth or longer; second, third, and fourth primaries longest; secondaries long, falling short of the tip of the wing by less than the length of the tarsus; wing six and two-thirds to seven times the length of the exposed culmen; tail slightly rounded; bill moderately stout and basally wide, its lateral outlines more or less concave, its width at base three-fourths to five-sixths of the length of exposed culmen; culmen strongly decurved; gonys moderately or slightly ascending and straight or slightly convex; narial bristles numerous and well developed.

Type.—Prionochilus quadricolor Tweeddale.

Remarks.—The narial bristles appear to be rather weaker in *Chromatociris bicolor inexpectata* than in the type of the genus, *Chromatociris quadricolor*, but otherwise the former is typical. The species referable to this group are:

Chromatociris bicolor bicolor (Bourns and Worcester).
Chromatociris bicolor inexpectata (Hartert).
Chromatociris quadricolor (Tweeddale).

Acmonorhynchus Oates.

Acmonorhynchus OATES, Fauna Brit. India, Birds, II, 1890, after October, p. 381 (type, by monotypy, *Prionochilus vincens* Sclater).

Diagnosis.—Similar to *Chromatociris*, but with bill narrower and more slender, its lateral outlines practically straight, its width at base only two-thirds of the length of exposed culmen; culmen not strongly decurved; second and third primaries longest.

Description.—First (outermost) primary not spurious, shorter than the fourth, sometimes only as long as the fifth; second and third primaries longest; secondaries long, falling short of the tip of the wing by less than the length of the tarsus; wing only six and two-fifths times the length of exposed culmen; tail moderately rounded; bill slender and relatively narrow, its lateral outlines practically straight, its width at base about two-thirds of the length of exposed culmen; culmen not strongly decurved; gonys moderately (not abruptly) ascending, and but little convex; narial bristles many and well developed.

Type.—Prionochilus vincens Sclater.

Remarks.—The Ceylon species *Prionochilus vincens* Sclater, for which this genus was originally instituted, seems to be strictly congeneric with *Prionochilus aureolimbatus* Wallace. Although we have not examined *Acmonorhynchus annae* Büttikofer*, this species is likewise apparently correctly referred

*Weber's Zool. Ergeb. Reis. Nederl. Ost-Indien, 1894, p. 302.

to the present group. The species apparently belonging to this genus are:

Acmonorhynchus vincens (Sclater).
Acmonorhynchus aureolimbatus aureolimbatus (Wallace).
Acmonorhynchus aureolimbatus sanghirensis (Salvadori).
Acmonorhynchus annae Büttikofer.

*Chilociris** gen. nov.

Diagnosis.—Resembling *Acmonorhynchus*, but wing more than 7½ times the length of the exposed culmen; secondaries falling short of the tip of the wing by the length of the tarsus or more; third and fourth primaries longest; bill stouter, its lateral outlines more concave, the culmen strongly decurved; the gonys much convex and abruptly ascending.

Description.—First (outermost) primary not spurious, equal to the fourth or shorter; third and fourth primaries longest; secondaries shorter, falling short of the tip of the wing by the length of the tarsus or more; wing long, 8 to 8½ times the length of the exposed culmen; tail square, or very slightly rounded; bill turgid, widening at base, its lateral outlines more or less concave, its width at base two-thirds to seven-tenths of the length of the exposed culmen; culmen strongly decurved; gonys abruptly ascending and very convex; narial bristles numerous and well developed.

Type.—*Prionochilus aeruginosus* Bourns and Worcester.

Remarks.—The type and only specimen of *Chilociris* has apparently given ornithologists considerable trouble to allocate generically. Originally described as belonging to *Prionochilus*, it has successively been placed in *Acmonorhynchus* and *Piprisoma*, but as is shown by an examination of its characters, it can not properly be referred to any one of them. It really forms a well differentiated monotypic genus, and should stand as *Chilociris aeruginosa* (Bourns and Worcester).

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* *Cheilos*, rostrum; *kiris*, ciris (avis mythica).

Key to Genera Allied to Prionochilus.

a^1. First (outermost) primary spurious.

b^1. Narial bristles few and weak; secondaries short, falling short of the tip of the wing by more than the length of tarsus; first primary not as long as tarsus..... *Pachyglossa.*

b^2. Narial bristles numerous and well developed; secondaries long, falling short of the tip of the wing by less than length of tarsus; first primary at least as long as tarsus.

c^1. Wing 7 to 7½ times the length of exposed culmen; second primary much longer than seventh; bill relatively broad and stout, decidedly turgid, its width at base at least seven-tenths of the length of exposed culmen; culmen much decurved; the gonys strongly convex and strongly ascending. *Anaimos.*

c^2. Wing about 6 times the length of exposed culmen; second primary equal to the seventh or shorter; bill relatively narrow and slender, not turgid, its width at base about three-fifths of the length of exposed culmen; culmen not much decurved; gonys not strongly convex nor strongly ascending..... *Charitociris.*

a^2. First (outermost) primary not spurious.

b^1. First primary much longer than fourth; narial bristles few and weak.

c^1. Secondaries short, falling short of the tip of the wing by more than the length of tarsus; width of bill at base not more than three-fifths of the length of exposed culmen; tail only slightly rounded..... *Piprisoma.*

c^2. Secondaries long, falling short of the tip of the wing by less than the length of tarsus; width of bill at base more than three-fifths of the length of exposed culmen; tail strongly rounded..... *Cryptociris.*

b^2. First primary not longer than fourth; narial bristles numerous and well developed.

c^1. Wing not decidedly less than 8 times the length of the exposed culmen; secondaries falling short of the tip of the wing by the length of the tarsus or more; bill somewhat more turgid; gonys much convex and abruptly ascending..... *Chilociris.*

c^2. Wing decidedly less than 8 times the length of exposed culmen; secondaries falling short of the tip of the wing by less than the length of the tarsus; bill less turgid; gonys but little, if any, convex, and not abruptly ascending.

d^1. Bill slender and narrow, its lateral outlines practically straight, its width at base two-thirds of the length of exposed culmen; culmen not strongly decurved; second and third primaries longest. *Acmonorhynchus.*

d^2. Bill relatively stout and basally wide; its lateral outlines more or less concave, its width at base three-fourths to five-sixths of the length of exposed culmen; culmen strongly decurved; second, third, and fourth primaries longest..... *Chromatociris.*

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NOTES ON THE FAMILY SYRPHIDÆ (DIPTERA) WITH THE DESCRIPTION OF A NEW SPECIES.

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The following notes have been taken from material collected at different times during the past three years. It is hoped that they may be of interest to other workers.

Myiolepta pretiosa, new species.

Female.—Head shining black; ground color obscured by thick whitish pollinose areas to the following extent: a triangular patch on each side of the front, just above the antennæ, with bases upon the orbits; a pollinose band from eye to eye, below the antennæ, the ends descending along the eyes and extending transversely, in their full width, between the cheek and face region to the edge of the mouth. This last portion of the pollinose area is twice as wide in extent as in *M. varipes* Loew. Thus the tubercular area of the face is left shining black. Profile of the face nearly as in *M. varipes*. Antennæ somewhat darker than in that species; third joint ochraceous brown, first and second joints slightly darker; arista similarly colored, blackened apically. Pollen of occiput grayish white; pile long, white. Ocelli white or yellowish.

Dorsum of thorax and scutellum shining black, with a slight metallic brassy cast. Pile short, appressed, white (pile in *varipes* brassy yellowish). Pleuræ shining black (vitreous); pile white, longer and more erect. On the extreme anterior portion of the dorsum of the thorax is found a band, or pollinose region, which (though in some species it may be reduced to spots), is characteristic for all species of *Myiolepta* with which I am acquainted (we might look upon the pollinose bands of *Brachyopa* as an extension of these). In *M. varipes* female, this band is cut off sharply in a line from humerus to humerus, while in the present species these bands proceed posteriorly for nearly a third of the length of the thorax; they are best seen from a slanting angle.

Abdomen entirely shining black, with a slight bluish or brassy tinge, a faint indication of whitish at the junction of the first and second segments on the lateral margins. A slightly opaque spot on the median anterior half of the second segment. Pile of the abdomen white, semi-recumbent, longer on the fourth segment, longest and erect on the lateral margins of the second segment. Venter pale on first and a portion of second segments; remainder dark. Halteres dirty light yellowish.

Legs. Anterior side of front coxæ opaque (shining black, nearly bare, in *M. varipes*) and densely gray pollinose. Trochanters and

femora shining fulvous, the latter becoming black on the distal half; tips of femora fulvous. Tibiæ brownish yellow, darker distally; whole front tarsi black (darker than in *varipes*), last three joints of middle and hind tarsi (last two joints in *varipes*) black, remainder clear, light yellow. Pile of legs, including tibiæ and tarsi, white. Wings as in *M. varipes*.

Length, 7 to 8 mm.

Type and one paraytpe, both females, taken by the author from flowers of *Spiræa van-houtei* on April 7, 1922, and May 6, 1920, at Mississippi A. and M. College. Types in the collection of the author.

Myiolepta varipes Loew.

Specimens studied in comparison with the above were quite constant. They vary a little in size. In the males the yellow color extends narrowly on to the third segment, and occupied in the females nearly all of the second. Five specimens from the Mississippi A. and M. College, May 6, 12, 1920 and 1921, March 19, 1921, March 6, and April 7, 1922. Taken at flowers of *Spiræa van-houtei*. Additional specimens, Hinckley, Ohio, August 1, 1901, (J. S. Hine), Clemson College, South Carolina, 1920 (M. R. Smith).

Myiolepta nigra Loew.

One specimen. Mississippi A. and M. College, May 12, 1920.

Myiolepta strigilata Loew.

Taken with the preceding species from *Spiræa van-houtei*. Mississippi A. and M. College. May 6, 1920; March 19, April 4, 1921; March 24, 1922. Also from College Station. Texas. April 12, 1915 (H. J. Reinhard).

Microdon scitulus Williston

Found in abundance, on the edge of a cypres swamp, flying over and resting on the leaves of plants close to the ground at Greenville, Mississippi, Sept. 18, 1920, and Sept. 11, 1922. Also taken at Mississippi A. and M. College, May 13, 1921, and Memphis, Tennessee, Sept. 7, 1920. Professor Jas. S. Hine refers to this species as *M. coarctatus* Loew, Ohio Naturalist, XIV, 334.

Microdon baliopterus Loew.

One specimen from Kingsville, Texas, July 6, 1921, and several specimens on foliage at Harlingen, Texas, July 18, 1921, (F. M. Hull). Two were taken at Brownwood, Texas, June 24, 1921, (R. H. Painter).

Microdon pallipennis Snow.

Not recorded since first described. Two specimens were collected by Mr. R. H. Painter, at Austin, Texas, April 10, 1921.

Volucella obesa Fabr.

I have a male and a female of this species taken at Riverton, New Jersey, July 3, 1920, resting on foliage, by Mr. R. H. Painter. A third was observed on leaves of *Clethra alnifolia*, but not upon the flowers. The female is peculiar in that the whole thorax and abdomen as well as the front and face, are a deep metallic reddish bronze color. Practically the only greenish tinge upon it is in the eyes. Otherwise it appears to be the same in detail as typical *obesa*. The male is deep metallic green and shows no variation save that the second abdominal segment has two large moderately shining black spots, separated by a narrow median line of metallic green. This record marks a considerable extension of the range of the species.

Volucella pallens Wied.

One specimen, Austin, Texas, Sept. 30, 1922. (R. H. Painter)

Volucella fraudulenta Williston.

About seven specimens of this species were taken hovering a foot or so above the ground, and making a faint humming sound, at Harlingen, Texas, June 22, and July 24, 1921. They were on the edge of an open field and were observed only about 8 o'clock in the morning and by 9 o'clock they had disappeared. They are somewhat larger (length 10 to 12 mm.) than the typical specimens of Williston, but agree in having the light markings of the abdomen as well as the face tinged with yellowish. Three specimens from San Angelo, Texas, Sept. 13, 1921, (R. H. Painter), differ in lacking this color and having at least the first two abdominal bands nearly clear hyaline. They are eight to ten millimeters in length.

Baccha lineata Macq.

Baccha lineata Macq., *Dipt. EXot., Suppl. 1, 139.*
Baccha livida Schiner, *Novara, 343.*
Baccha tropicalis Town., *Jour. N. Y. Ent. Soc., v. 172.*
(?) *Baccha flavipennis* Wied., *Auss. Zweifl., ii, 123.*

Five or six specimens of this beautiful species were taken at Harlingen, Texas, about shrubs and flowers. I believe the above synonymy is correct. Harlingen is fifteen miles from Brownsville, (the type locality of Townsend's species) and my specimens agree in detail with his description, with the exception that he does not mention, in the male, a second pair of brownish lines, enclosing the median longitudinal pair, together with brownish lateral margins, on the third, fourth and fifth abdominal segments. He does describe such lines for the female. However, both the thorax and abdomen are very apt to become peculiarly discolored with brown or black and the linear marking obliterated. When fresh the abdominal coloring is, save for the brown markings, clear amber yellow. Professor Jas. S. Hine, Ohio Naturalist, xiv, 336, has already remarked on the relationship of *lineata* Macq. to *livida* Schiner. A comparison of the above mentioned specimens with his material from Guatemala, Honduras, and British Guiana, only confirms this.

Townsend does not mention a light brownish, subapical band on the hind femora. Some, not all, of the specimens have such a band in addition to the similarly infuscated area on the posterior tibiæ. The occiput likewise varies from yellow to gray pollinose. The infuscation of the wings seems to be slightly variable, with, in the female, a greater extent of hyaline portion in the apical half of the wing. Nearly the whole insect has a peculiar glassy, or vitreous appearance, as if it had been varnished.

I am led further by a study of the descriptions, and the notes by Williston, Trans. Amer. Ent. Soc., xv, 267–268, in connection with the present material, to doubt the distinction of *Baccha flavipennis* Wied. The lack of Brazilian material forbids a more definite statement.

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